

Assessment of Petrol Stations Locations in Port Harcourt, Rivers State, Nigeria Using Geospatial Techniques

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Abstract

This study was conducted in Port Harcourt City Local Government Area of Rivers State. The aim of the study is to analyze the location of filling stations in Port Harcourt Metropolis against the physical planning standards set by Department of Petroleum Resource (DPR). The research used geographic information system (GIS) based analysis. Global positioning System GPS Garmin 76CSX was used to capture the location of the filling stations and names of the filling stations were obtained from DPR Port Harcourt Office. The aerial photo of Port Harcourt City and the Local Government shape file were obtained from the Office of the Surveyor General of Rivers State. The filling stations field data were processed in excel spread sheet and imported to ESRI ArcGIS 10.1 where all the analyses were performed. The study conducted shows a total number of 53 petrol filling stations located on major and minor roads in Port Harcourt City. It also shows that 25(47%) out of 53 petrol stations complied and 28(53%) petrol stations do not comply with DPR guidelines. Finally, the study recommends regular monitoring by the regulating bodies to ensuring total compliance at all level of the guidelines for the safety of the general public.

Key Words: Filling stations, spatial distribution, location, geodatabase, conformity, Port Harcourt.

I. INTRODUCTION

Petrol filling stations are facilities established to serve the public with sales of petroleum products. Therefore, petrol stations should be located not only where they are accessible but where they can be easily located by strangers. Specifically, petrol stations should be placed where they will not cause danger and congestion as, much as possible (KASUPDA, 2009). According to Abdullahi (2012) filling stations could be distributed rationally according to the size, spacing or distance and population to be served. However, in Nigeria, there is a guideline for location and operation of petrol stations. The issuance of license to all petrol stations is vested with the Department of Petroleum Resources (DPR). It is the responsibility of DPR to determine whether or not an application is suitable for "Approval to Construct" (ATC) a petrol station. In urban cities where there is no proper coordination of development, petrol stations are one of the contributing factors of traffic, explosion and fire (Samuel, 2011). For example, in Port Harcourt, some of the filling stations are too close to one another and no adequate set back from roads. GIS techniques can be employed to enhance the location of infrastructures and assessment for proper distribution within a city (Oloko-oba et' al 2016, Abdullahi 2012). Therefore, there is need for a study on the spatial analysis of the distribution and location of filling stations in Port Harcourt.

Statement of the Problem

In locating petrol stations, it is important to take some precautionary measures like locating them at a required distance from buildings; places of public assembly such as markets, hospitals and schools and areas of high traffic congestions and residential buildings (Odeh, 2017). This should be in accordance with the guidelines provided by the Department of Petroleum Resources that the distance between two nearest petrol stations should be 400m and 15m set back from road to shun possible hazards (DPR, 2007).

Despite this however, it is common to see petrol stations located in the midst of residential houses or sharing walls with people houses in Port Harcourt City. It is therefore against this background that the study examined the conformity of those petrol station sites in relation to DPR standard.

Aim of the study

The study aimed at assessing the spatial distribution and conformity of petrol filling stations with DPR regulations in Port Harcourt City Local Government Area.

II. STUDY AREA

The Study area (Port Harcourt City) is one of the 23 local governments and capital of Rivers state, found in the south southern part of Nigeria, otherwise called the Niger Delta Region of Nigeria as shown in figure 1. It has an area of 360sqkm (140sqmi), with a population of 1,382,592 (2006 Census). It is located between latitude $4^{\circ} 39' 45''$ and $4^{\circ} 50' 00''$ and longitude $6^{\circ} 56' 15''.6$ and $7^{\circ} 7' 32''$.

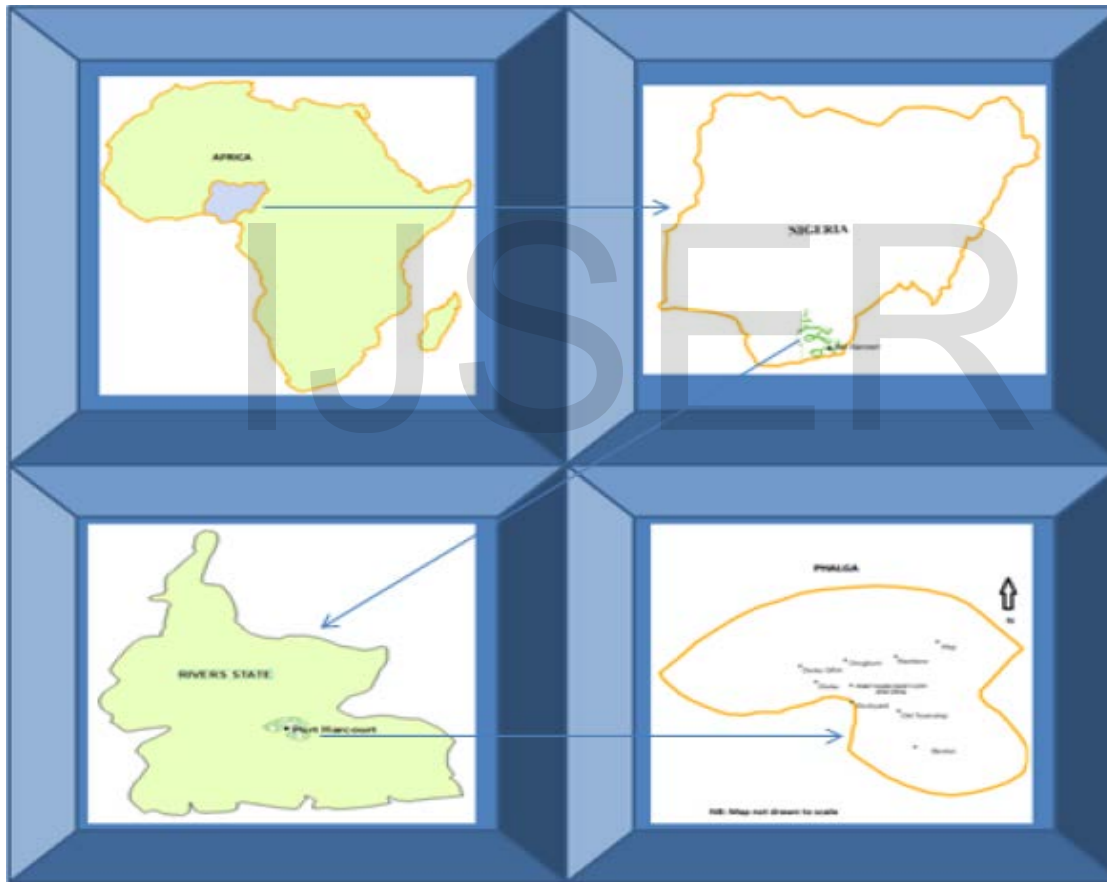


Figure 1. Study Area (Port Harcourt City).

III. METHODOLOGY

Dataset

Dataset for this study were obtained through field measurement. The hand held Global Positioning System (GPS) receiver was used to determine the coordinates of the petrol stations across the entire routes in the study area (Table 1).

Records from DPR Port Harcourt office and Office of the Surveyor General of Rivers State were equally sourced. Excel spread sheet was used to enter the names of the filling stations, the streets address and their coordinates. The data were processed, converted and plotted as points in ArcGIS environment (Figure 2).

Personal Geodatabase

Area

Personal Geodatabase is one of the data management tools used to store, organize and distribute data. Stated as one of the conditions to be met for approval of petrol station is that the size of site should be up to two plots of land about 1000m². With the creation of Personal Geodatabase, sizes of the filling stations identified in Port Harcourt City were digitized using polygon which made possible their respective areas in square meters to be generated and obtained in the attributes table (Figure 4 and 5).

Buffer Analysis

Buffer is a region created around an object. It could be in linear, polygon or point. DPR stipulates that the distance between two filling stations on the same road should not be less than 400m apart. Therefore, the same 400m distance was used to carry out buffer analysis (Figure 3) to check if there is conformity with the guidelines.

The methodology was subdivided into various steps such as: Planning stage, Data acquisition, Digitization/Data conversion and coordinate plotting, GIS database design and creation, GIS analysis and results presentation as shown in the flowchart.

Data Analysis

The petroleum filling station amendment decree no. 37 of 1977 safety rules and regulations stipulate site inspection by DPR of proposed filling station, so as to among other things, issue report on the following basic requirements: -

- i. Size of the proposed site (not less than 2 plots of land).
- ii. Whether site lie within pipeline or electricity high tension cable Right Of Way (ROW).
- iii. Distance from the edge of the road to the nearest pump (not less than 15 meters).
- iv. The number of petrol stations within 2km stretch of the site on both sides of the road will not be more than four, including the one under consideration.
- v. The distance between an existing station and the proposed one will not be less than 400 (four hundred) meters.
- vi. The drainage from the site will not go into a stream or river.
- vii. In some instances where site is along Federal Highway, a letter of consent from the Federal Highway is required.
- viii. DPR guided/supervised EIA study of the site by DPR accredited consultant

This study is concerned with regulation number i & v which state that:

- a) The size of the propose site should not be less than two (2) plots of land.
- b) The distance between an existing station and the proposed one will not be less than 400m.

Buffering technique in the GIS environment was used to analyze the spatial conformity of petrol filling stations across the study area in relation to required standards.

Table 1: Names and coordinates of petrol stations in Port Harcourt City.

S/N	Name	Eastings	Northings	Route
1	MRS	280179	527130	Bernard carr St
2	Forte Oil	280138	527162	Station Rd
3	Rain Oil	280115	527194	Station Rd
4	Oando	280070	527312	Station Rd
5	Total	280009	527406	Station Rd
6	Forte Oil	279918	527481	Station Rd

7	Eterna	278384	529850	Aba Rd
8	Con Oil	278324	530014	Aba Rd
9	MRS	278536	530276	Aba Rd
10	Total	279091	531274	Aba Rd
11	Mobil	279233	531561	Aba Rd
12	Total	278990	533236	Aba Rd
13	Mobil	279205	532706	Aba Rd
14	Oando	278431	530241	Aba Rd
15	Forte Oil	279707	530494	Eastern by pass
16	Forte Oil	279518	530657	Eastern by pass
17	Oando	280939	531644	Trans Amadi Rd
18	Con Oil	281182	530572	Amadi Round About
19	Forte Oil	282444	530386	Odili Road
20	Resto Park	282893	530557	Odili Road

Table 2: Names and area of petrol stations in Port Harcourt City.

S/N	Name	Area (sqm)	Address
1	MRS	522.509384	Bernard carr St
2	Forte Oil	398.037365	Station Rd
3	Rain Oil	191.138721	Station Rd
4	Oando	421.806942	Station Rd
5	Total	196.825406	Station Rd
6	Forte Oil	80.338131	Station Rd
7	Eterna	627.381302	Aba Rd
8	Con Oil	2604.783203	Aba Rd
9	MRS	2004.496908	Aba Rd
10	Total	491.068893	Aba Rd
11	Mobil	2036.771762	Aba Rd
12	Total	1501.975217	Aba Rd
13	Mobil	3409.176295	Aba Rd
14	Oando	1264.594652	Aba Rd
15	Forte Oil	856.455478	Eastern by pass
16	Forte Oil	942.384138	Eastern by pass
17	Oando	5678.581794	Trans Amadi Rd
18	Con Oil	413.221543	Amadi Round About
19	Forte Oil	1140.445426	Odili Road
20	Resto Park	1275.689098	Odili Road

IV. RESULTS AND DISCUSSION

The field observation shows that there are a total of 53 petrol stations within the study area sited along minor and major roads though only 20 are listed on table 1 and 2. There are 2 on Harold Wilson drive, 1 on kolokuma street, 3 on Aggrey road, 1 on Bernard Carr Street, 5 station road, 3 on industry road, 8 on Aba road, and 9 on Ikwerre road. Others that were also captured are 1 on Olu-Obasanjo road, 3 on Abuloma road, 2 on Slaughter-Okuru link road, 2 in Amadi-ama, 4 on eastern-by-pass, 3 on Dr. Peter Odili road, 1 on Rivers State University campus, 2 on Moscow road, 1 on Building material road, and 1 on Echue Street.

However, from the query that was performed, out of 53 filling stations, 25 actually complied with DPR guidelines on plot size of proposed site. Their level of compliance was acceptable because each of them during query displayed an area of plot size of 1000m² and above (figure 4). The remaining 28 violated the DPR safety guidelines on a two plot of land as plot size of what a petrol station should occupy. Specifically, the 28 filling stations occupy space less than 2 plots of land. From the query results in figure 5, all the 28 filling station occupy space less than 1000m² (2 plots of land).

Therefore, it then follows that 25 filling stations which is 53% out of the total figure complied with DPR standard and 28 filling stations which form 47% of the total figure violated the guidelines (figure 8).

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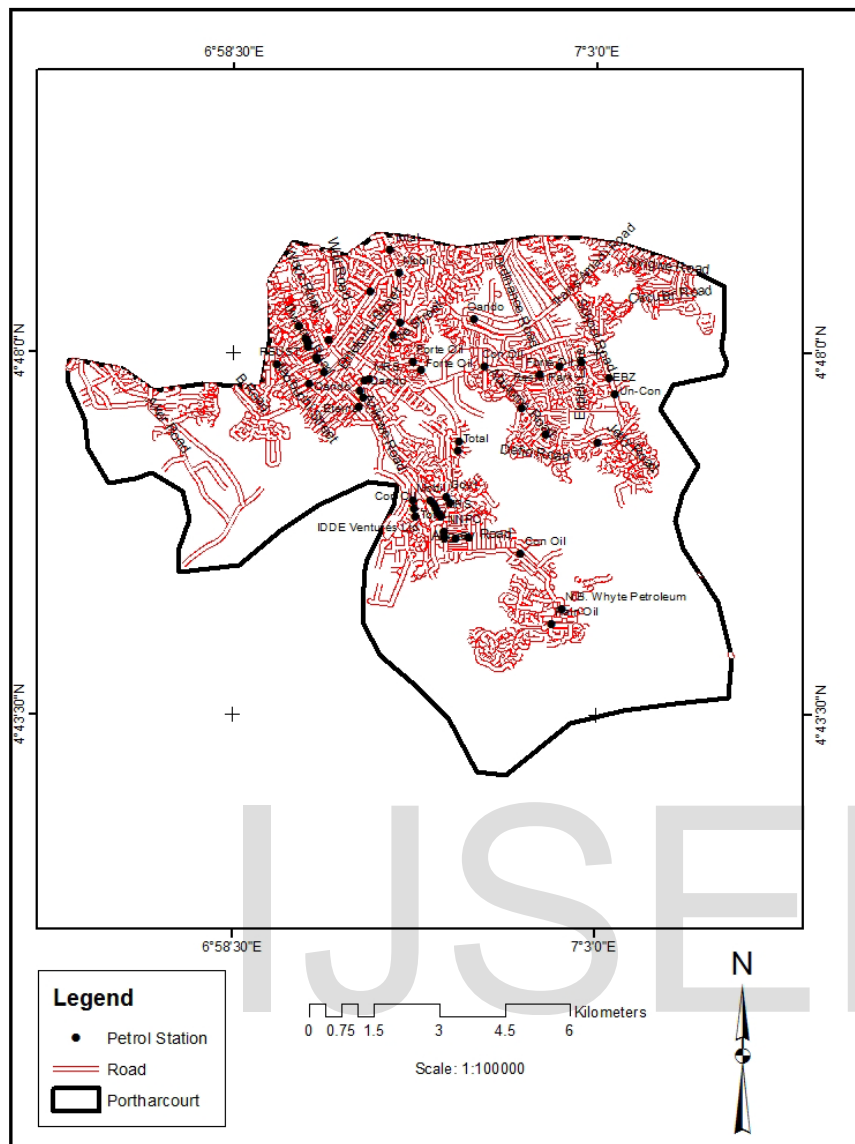


Figure 2: Port Harcourt City showing the location of filling stations.

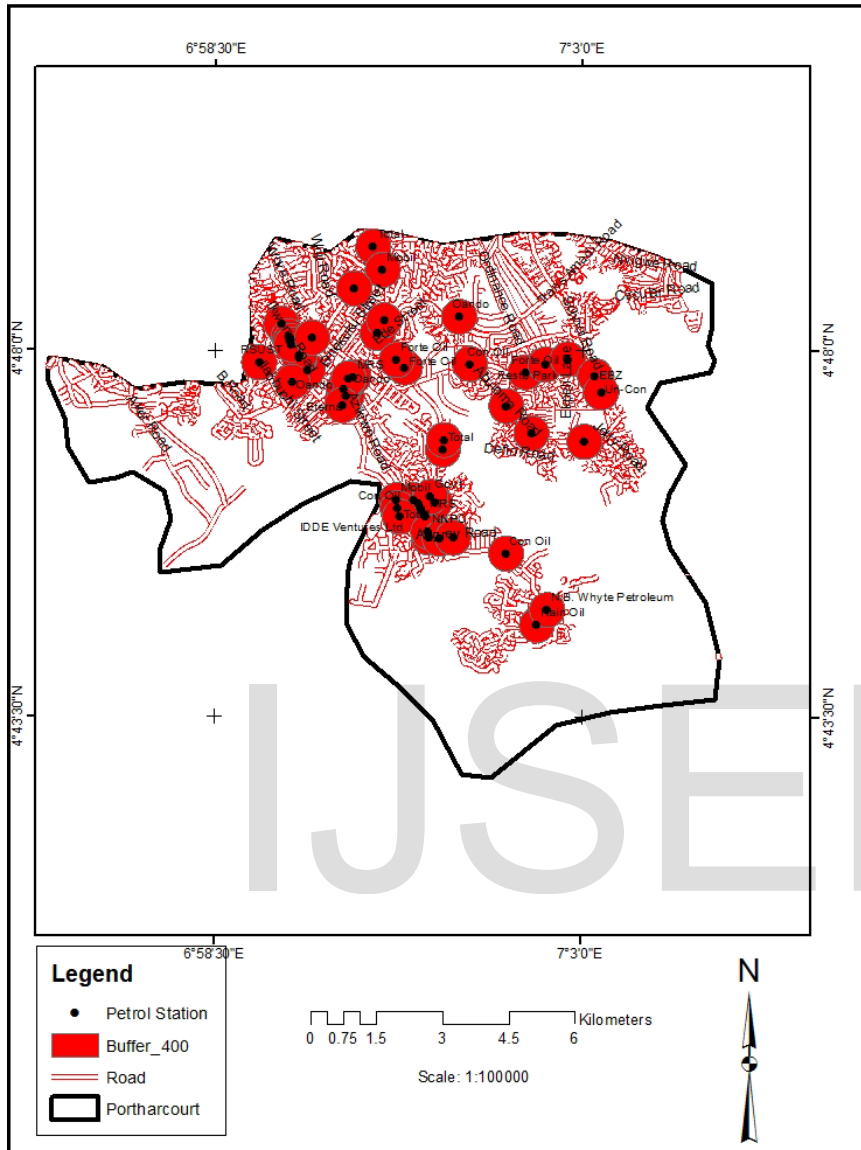


Figure 3: Port Harcourt City showing buffer overlay.

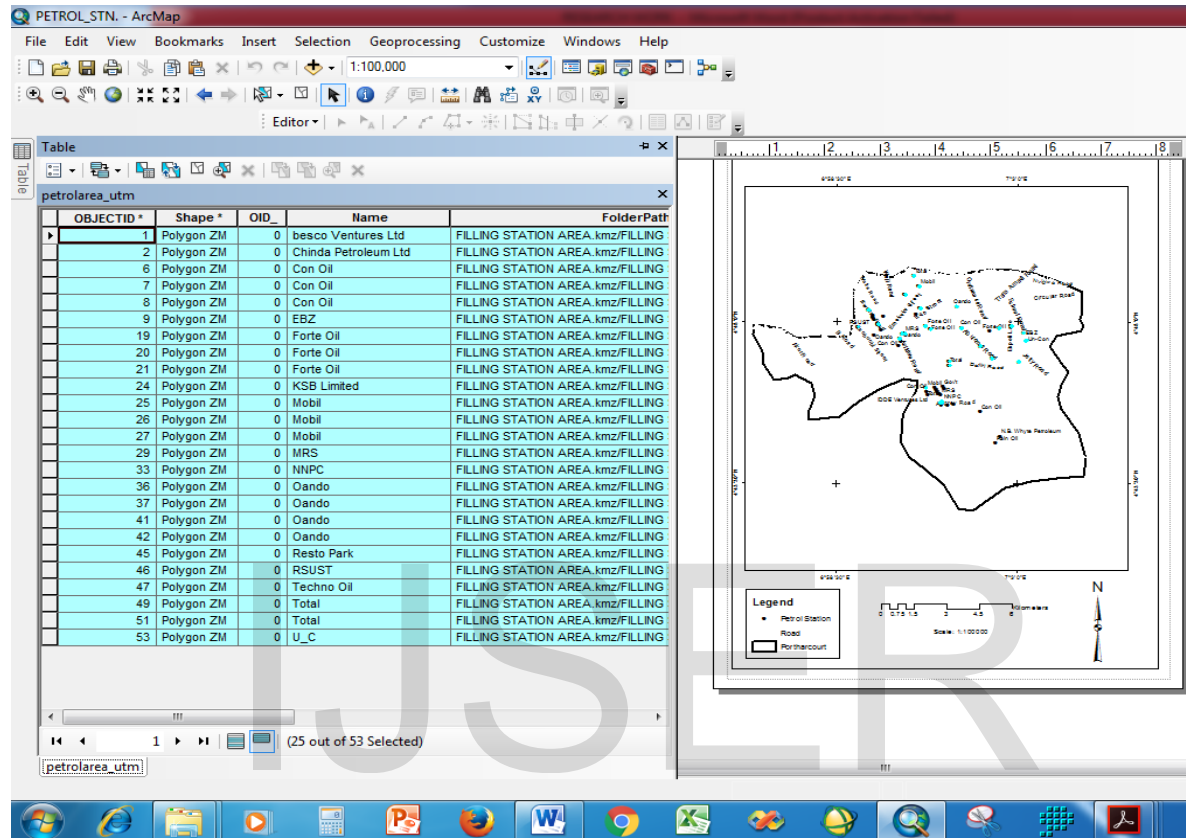


Figure 4: Query result showing filling stations with plot size above 1000m².

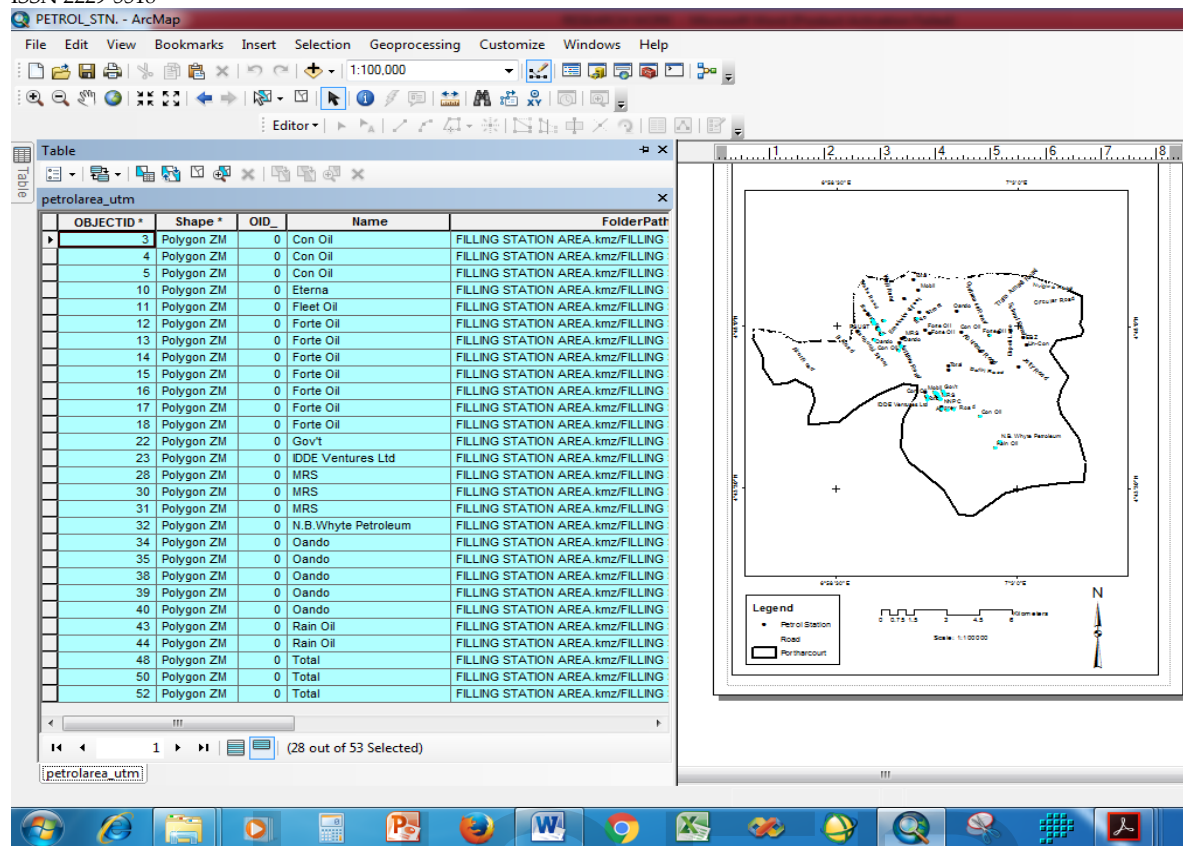


Figure 5: Query result showing filling stations with size below 1000m².

Areas of each petrol station in figure 4 and 5 are the areas from the attribute table through query analysis performed in ArcGIS 10.1 environment. The color green show successful query and on the bar below is the query results (Figure 4 and 5).

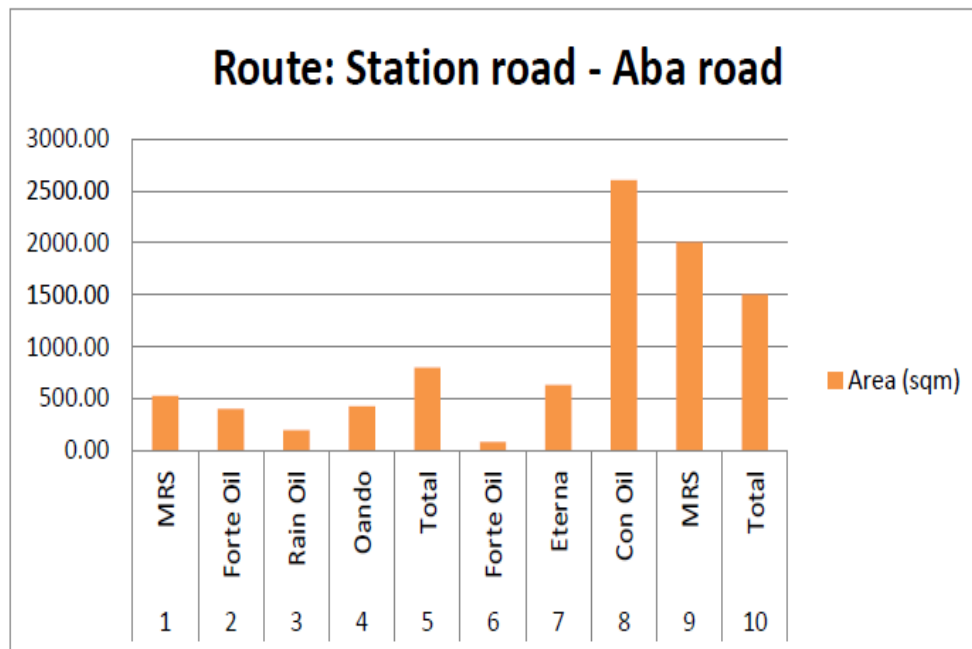


Figure 6: Chart showing area of filling stations (1-10).

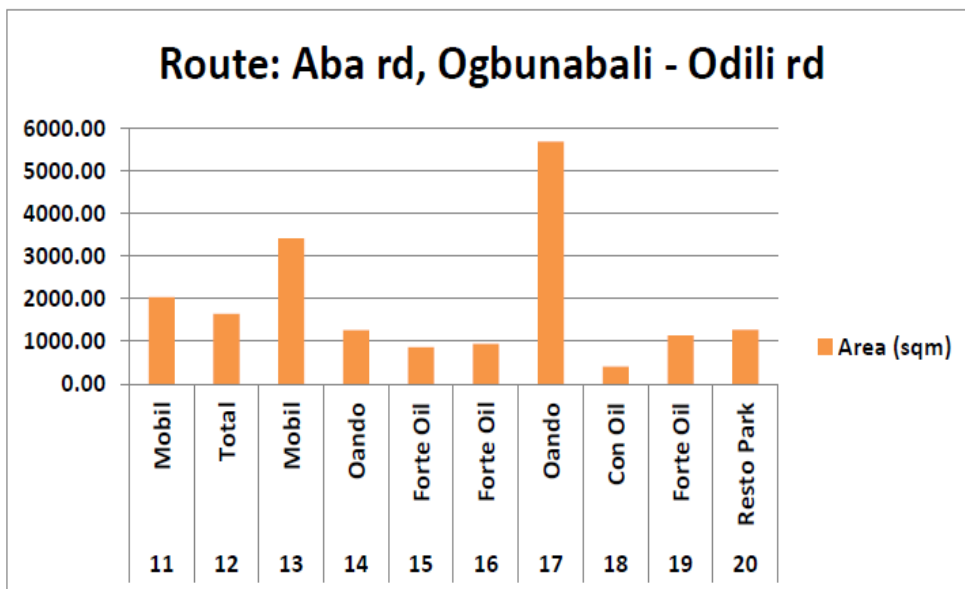


Figure 7: Chart showing area of filling stations (11-20).

Filling stations were captured and plotted with bar charts (Figure 6 and 7) according to the route traversed at the time of visiting the site. On the x-axis is the filling stations and their serial numbers while on the y-axis are their respective areas measured in square meters.

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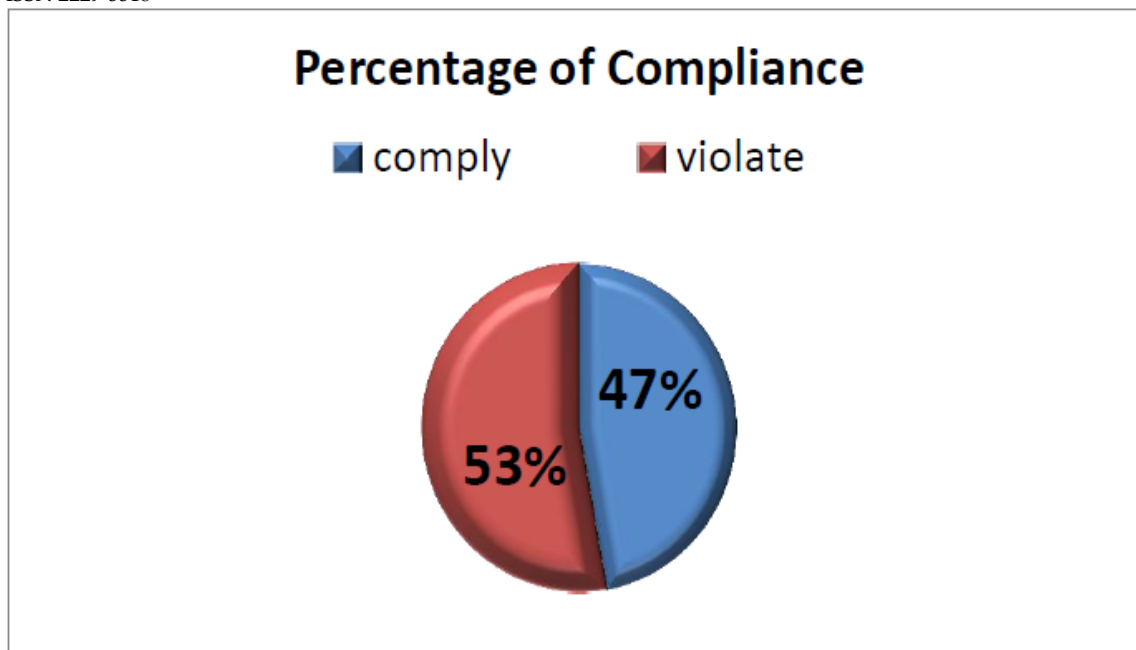


Figure 8: Showing percentage of compliance.

V. CONCLUSION & RECOMMENDATION

Petrol station is one investment that is lucrative in Port Harcourt over the years as a result of the rapid growing population and increase in transportation system. However, their number and suitability on sites as provided by DPR guidelines have not been followed. The analysis of the spatial distribution of filling stations in the study area reveals that conformity to approximately 1000m² required size of proposed filling station site was met by only 25(47%) out of the 53 petrol filling stations in the study area, while the remaining 28(53%) did not conform with DPR regulations and guidelines.

To ensure public safety this study therefore makes the following recommendations:

The study recommended an improved enforcement of all applicable legislations and procedure for siting petrol filling stations in the city of Port Harcourt.

The study finally recommended that regular and effective monitoring should be carried out by the regulating bodies to ensuring total compliance at all level of the guidelines for the safety of the general public.

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